said substrate, and wherein the driving signal to the heat generating resistor is stopped when a discrimination is made that the maximum temperature may exceed 560°C, based on the temperature of the ink and the driving signal.

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22. (Amended) An apparatus according to Claim 21, wherein the ink contains a chelate agent.

24. (Amended) An apparatus according to Claim 21, wherein said protection film comprises a plurality of layers, and the layer that comes into contact with the ink is an anti-cavitation film made of amorphous alloy comprising Ta.

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REMARKS

This application has been reviewed in light of the Office Action dated September 19, 2001. Claims 1-26 are pending in this application. Claims 1-4, 6, 9, 10, 13, 14, 16, 19-22, and 24 have been amended only as to matters of form; the changes made do not, in any way, narrow the scope of any of these claims. Claims 1, 9, 13, and 19 are in independent form. Favorable reconsideration is requested.

The Office Action rejected Claims 1-3, 6-13, 16-21 and 24-26 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,448,273 (Klein et al.) in view of U.S. Patent No. 5,880,751 (Nishikori et al.), Claims 4, 5, 14 and 15 as being unpatentable over Klein et al. in view of Japanese Patent 10204351 (Hidetaka), and Claims 22 and 23 as being unpatentable over Klein et al. as modified by Nishikori et al., and further in view of Hidetaka.

The aspect of the present invention set forth in Claim 1 is an ink jet recording method for ejecting ink, where the method uses an ink jet head substrate that is

provided with a heat generating resistor. The heat generating resistor is coated with a protection film, and the ink is ejected by a pressure produced by generation of a bubble, where the bubble is created by boiling the ink by applying thermal energy to the ink through the protection film. The thermal energy is generated by a driving signal to the heat generating resistor and a recording mode is provided in which the ink, which has a maximum temperature at the surface of the protection film of 560°C, is ejected.

One important feature of Claim 1 is that the ink has a maximum temperature at the surface of the protection film of 560°C.

Klein et al., as understood by Applicants, relates to a thermal ink jet printhead with a protective layer, where the protective layer is apparently made of a thin film material and operates in a temperature range between 100°C - 600°C (see col. 7, lines 47-50). Even if the protective layer in Klein et al. operates at a temperature range between 100°C - 600°C, as stated above and in the Office Action, nothing in Klein et al. would teach or suggest an ink jet recording method, where the ink has a maximum temperature at the surface of the protection film of 560°C. In addition, Applicants submit that nothing in Klein et al. would teach or suggest the difficulties involved in the film boiling of the ink. For example, the fact that the minimum operating temperature in Klein et al. is 100°C shows that Klein et al. realistically does not consider the challenges involved in film boiling because, in order to produce the film boiling, it is necessary to heat the ink to a temperature of at least 300°C.

Nishikori et al relates to an ink ejection control method for an ink jet recording apparatus having a recording head, and an ink jet recording apparatus that includes the feature of detecting operating conditions relating to a state of ink ejection from the recording head. The Office Action relies on Nishikori et al. as disclosing, among other things, that the maximum temperature is controlled by controlling a pulse width of a

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driving signal applied to the heat generating resistor. Even if Nishikori et al. does so teach how to control a pulse width to a heat generating resistor, nothing in Nishikori et al. would teach or suggest an ink jet recording method, where the ink has a maximum temperature at the surface of the protection film of 560°C.

Applicants submit that, at least for the reason discussed above, the proposed combination of Klein et al. and Nishikori et al., assuming such combination would even be permissible, would still fail to teach or suggest an ink jet recording method where the ink has a maximum temperature at the surface of the protection film of 560°C, as recited in Claim 1. Accordingly, Applicants submit that Claim 1 is patentable over these two patents, taken separately or in any proper combination.

Independent Claims 9, 13, and 19 include the same feature of ink having a maximum temperature at the surface of the protection film of 560°C, as discussed above in connection with Claim 1. Accordingly, Claims 9, 13, and 19 are believed to be patentable for at least the same reasons as discussed above in connection with Claim 1.

A review of the other art of record, including Hidetaka, has failed to reveal anything that, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as applied against the independent claims herein. Therefore, those claims are respectfully submitted to be patentable over the art of record.

The other rejected claims in this application depend from one or another of the independent claims discussed above, and, therefore, are submitted to be patentable for at least the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, individual reconsideration of the patentability of each claim on its own merits is respectfully requested.

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In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York Office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address listed below.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Amended) An ink jet recording method [of] for ejecting ink, said method using an ink jet head substrate provided with a heat generating resistor, [which is] the heat generating resistor being coated with a [protecting] protection film, wherein the ink is ejected by a pressure produced by generation of a bubble, the bubble being created by film boiling [of] the ink [caused] by [application of] applying thermal energy to the ink through the [protecting] protection film, the thermal energy being generated by a driving [of said] signal to the heat generating resistor, [the improvement residing in that] said method further comprising:

[there is provided] providing a recording mode in which the ink is ejected, [with] the ink having a maximum temperature at the surface of [said protecting] the protection film [which is contacted to the ink not higher than] of 560°C.

2. (Amended) A method according to Claim 1, wherein the maximum temperature applied to the ink is controlled by controlling a pulse width of [a] the driving signal applied to the heat generating resistor.

3. (Amended) A method according to Claim 1, wherein a temperature of the substrate is measured, the driving [of] signal to the heat generating resistor [is] being stopped when a discrimination is made that [control is not possible to make] the maximum temperature [not higher than] may exceed 560°C, [on the basis of] based on the temperature of the ink and [a] the driving signal.

4. (Amended) A method according to Claim 1, wherein the ink contains a chelate agent.

6. (Amended) A method according to Claim 1, wherein said [protecting] protection film comprises a plurality of [layer] layers, and [a layer contactable to the ink] the layer that comes into contact with the ink is an anti-cavitation film made of amorphous alloy comprising Ta.

9. (Amended) An ink jet head substrate comprising a heat generating resistor, a [protecting] protection film with which said heat generating resistor is coated, wherein heat generated by said heat generating resistor is applied to ink through said [protecting] protection film to eject the ink, [the improvement residing in that:]

wherein a maximum temperature at a surface [of] where said [protecting] protection film [contacted to] comes into contact with the ink is [not higher than] 560°C during driving of said heat generating resistor.

10. (Amended) A substrate according to Claim 9, wherein said [protecting] protection film comprises a plurality of [layer] layers, and [a layer contactable to the ink] the layer that comes into contact with the ink is an anti-cavitation film made of amorphous alloy comprising Ta.

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13. (Amended) An ink jet head comprising an ink jet head substrate including a heat generating resistor, and a [protecting] protection film with which said heat generating resistor is coated, wherein heat generated by said heat generating resistor is applied to ink through said [protecting] protection film to create a bubble in the ink, [thereby] therein to eject the ink by a pressure caused by the creation of the bubble, [the improvement residing in that:]

wherein a maximum temperature at a surface [of] where said [protecting] protection film [contacted to] comes into contact with the ink is [not higher than] 560°C during driving of said heat generating resistor.

14. (Amended) An ink jet head according to Claim 13, wherein the ink contains a chelate agent.

16. (Amended) An ink jet head according to Claim 13, wherein [protecting] said protection film comprises a plurality of [layer] layers, and [a layer contactable to the ink] the layer that comes into contact with the ink is an anti-cavitation film made of amorphous alloy comprising Ta.

19. (Amended) An ink jet apparatus which includes an ink jet head comprising an ink jet head substrate, said ink jet head substrate including a heat generating resistor, a [protecting] protection film with which said heat generating resistor is coated, wherein

heat generated by said heat generating resistor is applied to ink through said [protecting] protection film to create a bubble in the ink, [thereby] therein to eject the ink by a pressure caused by the creation of the bubble, [the improvement residing in that:]

[there is provided] wherein a driving signal control means is provided for making a maximum temperature at a surface of said [protecting] protection film [contacted to] that comes into contact with the ink [not higher than] 560°C during driving of said heat generating resistor.

20. (Amended) An apparatus according to Claim 19, wherein said driving signal control means controls a pulse width of a driving signal applied to said heat generating resistor to control the maximum temperature applied to the ink.

21. (Amended) An apparatus according to Claim 19, wherein said ink jet head substrate includes a temperature detecting element for measuring a temperature of said substrate, and wherein the driving [of] signal to the heat generating resistor is stopped when a discrimination is made that [control is not possible to make] the maximum temperature [not higher than] may exceed 560°C, [on the basis of] based on the temperature of the ink and [a] the driving signal.

22. (Amended) An apparatus according to Claim 21, wherein the ink contains a chelate agent.

24. (Amended) An apparatus according to Claim 21, wherein said [protecting] protection film comprises a plurality of [layer] layers, and [a layer contactable to the ink] the layer that comes into contact with the ink is an anti-cavitation film made of amorphous alloy comprising Ta.

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